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Tunnel Component of the Tunnel & Reservoir Plan Proposed by the Metropolitan Sanitary District of Greater Chicago Mainstream Tunnel System, 59th Street to Addison Street

Environmental Protection Agency, Chicago, Illinois. Region V

Prepared for

Booz-Allen and Hamilton, Inc., Bethesda, Maryland

Mar 76

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PB 263 301

DRAFT ENVIRONMENTAL IMPACT STATEMENT

For the

TUNNEL COMPONENT OF THE TUNNEL AND RESERVOIR PLAN (TARP) PROPOSED BY THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

MAINSTREAM TUNNEL SYSTEM, 59th STREET TO ADDISON STREET

Prepared by
United States Environmental Protection Agency
Region V
Chicago, Illinois 60604

March 1976

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ENVIRONMENTAL IMPACT STATEMENT

TUNNEL COMPONENT OF THE

TUNNEL AND RESERVOIR PLAN

PROPOSED BY THE

METROPOLITAN SANITARY DISTRICT

OF GREATER CHICAGO

MAINSTREAM TUNNEL SYSTEM

59th STREET TO ADDISON

Prepared by

United States Environmental Protection Agency

Region V

Chicago, Illinois

and

Booz, Allen and Hamilton Inc.

Bethesda, Maryland

APPROVED BY:

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Regional Adminstrator
March 1976

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5. Federal, State, and Local Agencies and Individuals Notified of this Action

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Senator Charles H. Percy
Representative George M. O'Brien
Representative Philip M. Crane
Representative Frank Annunzio
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EXECUTIVE SUMMARY

FOREWORD

This executive summary supplements the Draft Environmental Impact Statement (EIS) on the Tunnel Component of TARP, specifically the Mainstream Tunnel System from 59th Street to Addison Street. Copies of the Draft EIS may be obtained by writing the U.S. Environmental Protection Agency, Region V, Planning Branch, EIS Preparation Section, 230 South Dearborn Street, Chicago, Illinois 60604; or by telephoning the TARP project officer at (312)353-7730.

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I. BACKGROUND INFORMATION

This chapter first defines the legal basis and the scope of the EIS and then describes the authority and program of the applicant for EPA funding, the MSDGC. Finally, the history and objectives of the Tunnel and Reservoir Plan (TARP) are reviewed. This chapter of the executive summary corresponds to Chapter I of the environmental impact statement (EIS).

1.1 LEGAL BASIS FOR THE EIS

The U.S. Environmental Protection Agency (EPA) is the administering agency for a major Federal environmental program entitled "Grants for Construction of Treatment Works."[1] This program allows the EPA administrator to provide financial aid to any state, municipality, intermunicipal agency, or interstate agency for the construction of publicly owned water pollution control facilities. The program will encourage reduction of point sources of water pollution and improve national water quality.

The EPA's granting of funds for a water pollution control facility may require an EIS. Each proposed water pollution control facility is evaluated on a case-by-case basis by the appropriate EPA regional office to determine whether the proposed facility is expected to have significant environmental effects or be highly controversial. The EPA has prepared this EIS because it expects the environmental effects of the tunnel system to be significant.

This EIS is being issued pursuant to P.L. 91-90, the National Environmental Policy Act (NEPA) of 1969, and Executive Order 11514, "Protection and Enhancement of Environmental Quality" dated March 5, 1970. Both NEPA and Executive Order 11514 require that all Federal agencies prepare such statements in connection with their proposals for major Federal actions significantly affecting the quality of the human environment.

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1 Authorized by Title II, Section 201(g)(1), of the Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500 (FWPCA.A).

This EIS has been prepared in accordance with the regulations and guidance set forth in the President's Council on Environmental Quality (CEQ) Guidelines dated August 1, 1973, and the EPA's Final Regulations 40 CFR-Parg 6, dated April 14, 1975.

1.2 SCOPE OF THE EIS

The EIS addresses the cumulative effects of constructing and operating three conveyance tunnel systems which are part of the total Tunnel and Reservoir Plan (TARP) proposed by MSDGC. These three tunnel systems are:

- Mainstream (59th Street to Addison Street)
- Calumet
- Lower Des Plaines.

Where appropriate, this statement also assesses the effects associated specifically with a segment of the Mainstream Tunnel system route from 59th Street to Addison Street. Two subsequent statements will address separately the effects associated with the Calumet Tunnel system and the Lower Des Plaines Tunnel system. These tunnel systems comprise what is referred to in the statement as "TARP, Phase 1."

The subject of these statements is confined to the tunnel systems and their associated components because EPA is now considering whether to grant funds to construct these tunnels under its water pollution control authority. Other components of TARP, including the reservoirs, flood relief tunnels, instream aeration, and wastewater treatment plant improvements, are either ineligible for EPA funding or are not now under consideration for construction grants. Therefore, these other components are not considered to be part of the proposed action under review. The effects of these other components on water quality and the likelihood of their being financed is analyzed in this EIS in order to provide a context for evaluating the significance of the water quality improvements expected from the three tunnel systems.

1.3 IDENTIFICATION OF THE APPLICANT

The Metropolitan Sanitary District of Greater Chicago (MSDGC) is the construction grant applicant for the component of Tunnel and Reservoir Plan (TARP) addressed by this EIS. The MSDGC was organized in 1889 under an act to create sanitary districts to remove obstructions in the Des Plaines

and Illinois Rivers.[1] Under the provisions of the act, the MSDGC is responsible for providing surface water and sewage drainage within the District's boundaries, which it does by constructing necessary facilities, conveyance systems, and treatment plants. The MSDGC is authorized to treat wastewater, either totally or partially, from any municipality within its designated jurisdiction, as well as to own and operate all wastewater facilities located within the MSDGC jurisdiction.

The MSDGC service area is approximately 860 square miles. Approximately 44 percent of this area, or 375 square miles, is served by MSDGC-owned combined-sewer systems (see Figure I-1) in which wastewater or sewage collected in local sewer systems is conveyed to treatment plants. These systems serve 120 municipalities which have a total population of approximately 5.5 million. The District owns and operates 70.5 miles of navigable canals, 6 wastewater treatment plants, and approximately 440 miles of intercepting sewers. The three major plants (North-Side, West-Southwest, and Calumet) in the MSDGC service area have a secondary capacity of over 1,750 million gallons per day (MGD). The remaining plants have a combined tertiary capacity of over 70 MGD. A water reclamation plant, the John F. Egan plant, is presently under construction and will have a capacity of about 30 MGD.

1.4 PROJECT HISTORY

The MSDGC initiated its wastewater facilities planning study in September 1967, with a ten-year clean-up and flood control program. The objectives of the program are to solve the District's flooding problem, protect Lake Michigan from further pollution, and improve the water quality of rivers and streams in the Chicago metropolitan area. The Tunnel and Reservoir Plan (TARP) has evolved from this ten-year program.

Concerned officials from the State of Illinois, Cook County, the MSDGC, and the city of Chicago reactivated a Flood Control Coordinating Committee (FCCC) in November 1970 to investigate the pollution and flooding problems in the Chicago metropolitan area. The Committee's primary assignment was to develop a viable plan to minimize the area's

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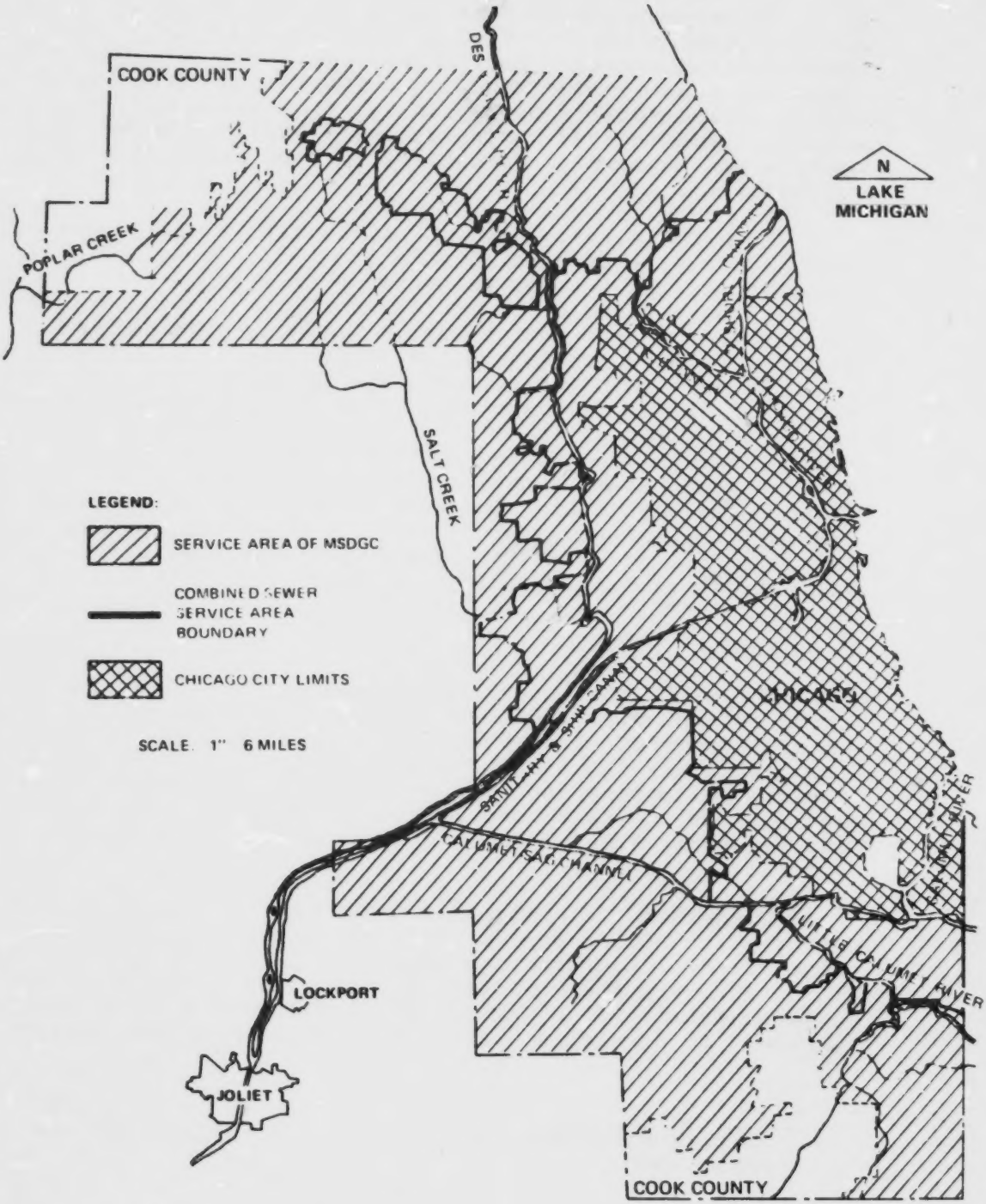
1 Illinois Revised Statutes, Chapter 42, Section 320, approved May 29, 1889.

FIGURE I-1
Metropolitan Sanitary District
of Greater Chicago
Service Area



pollutant discharges and the flooding caused by overflows of mixed sewage and wastewater. Another priority item in the plan was elimination of the need to release polluted river and canal flood waters into Lake Michigan. The Committee's plan was to address the combined-sewer area within Cook County, covering 375 square miles. The deliberations and studies of the FCCC and of a technical advisory committee which they formed resulted in the selection of TARP as less costly and more environmentally acceptable than the other plans they evaluated. The Committee then initiated additional studies to develop and refine TARP.

1.5 OBJECTIVES OF TARP

A primary objective of TARP is to improve surface water quality within the planning area. TARP is designed to meet the standards set forth in the "Water Pollution Regulations of Illinois."[1] These regulatory standards were established for three surface water-use classifications: (1) General (primary body contact), (2) Public and Food Processing (drinking water), and (3) Secondary Body Contact and Indigenous Aquatic Life. All surface waters in the State of Illinois have been given a water-use classification by the Illinois Pollution Control Board (IPCB) and should comply with the appropriate water quality standards. Details of these standards are presented in Chapter II of this EIS. Other important objectives of TARP are to:

- Preserve the health and well-being of the population
- Prevent further pollution of Lake Michigan due to backflow
- Utilize treated waste byproducts
- Prevent flooding.

The final TARP is a combination of several alternative plans designed to collect urban runoff during all wet weather conditions except those storms of a magnitude equal to the three most severe storms recorded to date by the U.S. Weather Bureau Service.

II. EXISTING ENVIRONMENTAL SETTING

To provide a basis for assessing the impacts of a proposed project, an EIS initially describes the existing natural, social, economic, and cultural setting of the area which may be affected by a project. This chapter summarizes the major findings of the EIS with respect to the natural and man-made environments of the Chicago metropolitan area. This chapter is divided into two sections which correspond to Chapters II and III of the EIS text: Natural Environment and Man-made Environment.

2.1 NATURAL ENVIRONMENT

The existing natural environment of the Chicago area summarized in this section focuses on those features relevant to impact assessment of the proposed TARP project. This section is divided into the following categories:

- Water Resources
- Land Resources
- Atmospheric Resources.

2.1.1 Water Resources

The surface water systems of the Chicago area consist of a network of rivers and canals whose natural flow into Lake Michigan is controlled by a series of locks and one lakes. These surface water systems include the Chicago River, the Sanitary and Ship Canal, the Calumet River system, and the Des Plaines River system. Lake Calumet and Lake Michigan also constitute an important part of the area's surface water resources.

The quality of the surface water systems is affected by steady-state effluent discharges and by injections or discharges of polluted wastewaters. The polluted wastewater results from overflows of combined-sewer systems during rainfall events of nominal size (approximately 0.1 inches or greater). The frequency of these rainfall events is approximately 100 times per year, and the resulting overflows are discharged directly to the Chicago area's streams and rivers.

Pollutant concentrations in the streams and rivers presently exceed water quality standards established by the State of Illinois Pollution Control Board. Concentration ranges of various pollutants in the Chicago area's surface systems are presented in Table II-1. Further details on the water quality of specific water systems are presented in Section 2.1.1 of the EIS.

Table II-1
Summary of Pollutant Concentration
Ranges in Chicago's Surface Water Systems

Pollutant	Chicago River — Sanitary and Ship Canal System	Calumet River System	Des Plaines River System	Applicable Illinois Standard
Dissolved oxygen (DO)	1.2 to 7.7 mg/l	1.9 to 9.0 mg/l	6.0 to 10 mg/l	4.0 mg/l (1977)[1] 5.0 mg/l min.[2]
Biochemical oxygen demand (BOD)	5.2 to 9.2 mg/l	4.1 to 7.3 mg/l	5.0 to 6.7 mg/l	10 mg/l[3]
Ammonia (as N)	0.8 to 6.2 mg/l	1.3 to 13 mg/l	0.3 to 1.2 mg/l	4.0 mg/l[1] 1.5 mg/l[2]
Suspended solids (SS)	19 to 54 mg/l	12 to 73 mg/l	29 to 68 mg/l	12 mg/l[3]
Fecal coliform	477 to 12,700 (counts/100 ml)	152 to 738 (counts/100 ml)	411 to 8,700 (counts/100 ml)	1000/100 ml[1] 200/100 ml[2]

1 Secondary Contact and Indigenous Aquatic Life Standards applicable to Chicago River-Sanitary and Ship Canal system and Calumet River system.

2 General Use Standard applicable to Des Plaines River systems.

3 Effluent Discharge Standard.

Serious public health problems involving contamination of Chicago's drinking water supply has led to implementation of regulatory measures to protect Lake Michigan, an important drinking water resource, from pollution. Locks and gates have been installed to divert river flows away from Lake Michigan, allowing eventual drainage into the Illinois River. Lake Michigan supplies most of the drinking water for the Chicago area. The withdrawal amount is approximately 1,600 cubic feet per second (CFS), and the maximum amount that can be withdrawn from Lake Michigan is 3,200 CFS.[1] This withdrawal limit, or allotment, is presently divided into three usage types: domestic water supply, indirect waterway diversion, and direct waterway diversion. The diversion usages allow improved effluent dilution and improved navigation.

* Supreme Court Decision.

In the Chicago metropolitan area, there are two main aquifer systems: the upper aquifer, which consists of glacial drift and dolomites, and the lower aquifer, which consists of dolomite and sandstone formations. Unconsolidated Quaternary deposits and Silurian dolomites of the upper aquifer are hydraulically connected and function, in most areas, as a single water-bearing unit. Clayey deposits in the glacial drift act as confining layers to create artesian conditions in the upper aquifer. The lower aquifer includes dolomite and sandstone formations extending from the base of the Maquoketa Group to the top of the Eau Claire shales of the Cambrian system. The average thickness of the upper aquifer and lower aquifer is approximately 400 feet and 1,000 feet, respectively. The sources of recharge for the groundwater in the upper aquifer are infiltration of precipitation and influent streams. The lower aquifer is recharged in parts of McHenry, Kane, and De Kalb Counties where the Maquoketa Group outcrops, and further west where the Group has been removed by erosion. With respect to using the aquifers as a water resource, studies indicate that the lower aquifer is capable of producing about 25 Million Gallons per Day (MGD) and the upper aquifer is capable of a potential yield of 108 MGD.

Discharges into the waterways of the Chicago area originate from several sources, including: wastewater treatment facilities, industrial plants, and combined-sewer overflows. Six wastewater treatment facilities currently discharge treated water to existing waterways. The outfalls are located adjacent to the facilities. Most of these facilities are in compliance with the BOD and SS water quality standards (under present permit conditions), and two smaller plants are within the ammonia-nitrogen standard. With respect to industrial plants, wastewater is conveyed to treatment plants and processed before discharging. The industrial waste load averages approximately 195 MGD. Combined-sewer overflows, which occur about 100 times per average year, inject pollutants in large amounts into waterways at approximately 640 outfall points in the Chicago area. During such events, minimum Illinois water quality standards established for restricted-use waters are not met.

Numerous water resource management programs have been initiated to address the flooding and/or pollution problems of the Chicago area. These programs have been or are currently being conducted either regionally or locally. A few of these programs include: the Section 208 Areawide Waste Treatment Management Planning program, the Chicago-South End of Lake Michigan study (C-SELM), the City of Chicago

Sewer Construction program, Thornton Quarry Flood Control project, and the Chicago Metropolitan Area River Basin Plan (CMARBP).

2.1.2 Land Resources

The Sanitary and Ship Canal and the Calumet-Sag Channel have significantly altered the natural drainage patterns which are from west to southwest in the area near Lake Michigan. Prior to construction of the Canal and Channel, the drainage flow was toward Lake Michigan. The flow is presently toward the Chicago River and the Sanitary and Ship Canal, which drain into the Illinois Waterway system. The overall low relief of the MSDGC combined-sewer system area makes it prone to flooding caused by sewer system backups and/or overbank flows. The areas with the highest overbank flooding potential lie along the North Branch-Chicago River and in the Calumet River system.

The Chicago area lies on the broad, gently sloping, northwesterly-trending Kankakee Arch. This arch, which connects the Wisconsin Arch to the northwest with the Cincinnati Arch to the southwest, separates the Michigan Basin from the Illinois Basin. The northeast sector of the Chicago area lies on the northeastern side of the Kankakee Arch, while the southwestern sector of the Chicago area lies on the southwest flank of the Arch. In the Chicago area, overall, a number of gentle east-west-trending folds are superimposed on the area's broad regional geologic structures. Numerous minor faults and several major faults have been mapped, including: the Sandwich fault near Joliet and the Des Plaines disturbance near the community of Des Plaines. The uppermost 500 feet of rock layers, particularly the dolomites and shales between the top of the Racine formation and the base of the Brainard formation, will be relevant to the proposed construction of the TARP tunnel systems. The surface layer (glacial deposits) has an average thickness of approximately 80 feet. Drop shaft and construction shaft installations will be constructed within this layer.

Based on 175-year historical earthquake records, four major earthquakes occurred within 100 miles of Chicago with intensities equal to or greater than MMI VIII (Modified Mercalli Intensity scale). These earthquakes originated at Fort Dearborn (Chicago) (1804), near Rockford (1909), near Aurora (1912), and near Amboy (1972). Within the MSDGC combined-sewer service area, there are 30 faults with moderate vertical displacement characteristics and 86 minor faults with small vertical displacement characteristics.

2.1.3 Atmospheric Resources

Air quality in the Chicago metropolitan area is presently monitored by the city of Chicago Department of Environmental Control and the Cook County Department of Environmental Control. A total of 61 monitoring stations have been established in Cook County; 30 of these are located within the city limits of Chicago. Based on the 1974 Annual Air Quality Report published by the State of Illinois EPA, ambient air quality standards were frequently violated at one or more stations. The pollutant standards violated include: sulfur dioxide, particulate matter, carbon monoxide, hydrocarbons, and photochemical oxidants (measured as ozone).

The existing outdoor noise levels in most areas of Chicago are caused mainly by street traffic. Other noise sources include trains, aircraft, and industrial plants in city areas, and power lawn mowers, power tools, and other motor-driven equipment in residential areas. Based on a recent EPA study, typical noise levels for the Chicago area ranged from 36.3 dBA (decibels-A scale) (night) to 106.2 dBA (day). The day-night level (L_{dn}) ranged from 59.0 dBA to 71.2 dBA (overall average).

2.2 MAN-MADE ENVIRONMENT

The various components related to man's activities in the Chicago area are summarized in this section. These components include: Socioeconomic, Land Use, Sensitive Areas, Financial and Labor Resources, Transportation, and Major Projects and Programs.

2.2.1 Socioeconomic

The Chicago metropolitan area has experienced growth and change in its demographic profile similar to other major cities in the United States. Chicago, the third largest standard metropolitan statistical area (SMSA) in the United States, has experienced typical population redistribution trends within the SMSA. The close-in suburban jurisdictions grew rapidly during the 1950's from a substantial in-migration of population from the south and an out-migration of people from the city of Chicago. During the 1960's, the counties adjacent to Cook County urbanized rapidly. Continued redevelopment of the City, when combined with smaller household trends, uncertainties regarding energy availability and cost, and the increasing cost of suburban new construction,

should result in a strengthening of the urban centers and a lessening of the outward population movements. Chicago's population is expected to stabilize after 1980.

Contract construction income accounts for less than eight percent of total earnings in the Chicago region. While average monthly wages for construction employment are high relative to other industries in the Chicago region, total earnings from contract construction have ranged from 6.5 to 7.7 percent of total earnings over the period 1950 to 1971. The construction industry is heavily unionized, and the current union hourly wage rate averages $11.02. (Refer to Table III-6 of the EIS).

Chicago has traditionally sustained strong construction activity in the public and private sectors. Major public redevelopment projects have stimulated private investment and development, particularly within the city of Chicago. Construction employment opportunities have thus attracted and created a large construction labor force. Construction employment in the Chicago SMSA numbered 136,897 people in 1970 or approximately 4.8 percent of the total employed. Construction employment in the Chicago SMSA accounted for 61 percent of total construction employment in the State of Illinois. The Chicago area construction work force is highly flexible and can expand rapidly, given the demand for construction services.

2.2.2 Land Use

The predominant land use bordering the Mainstream Tunnel route can be characterized by its industrial zoning; large portions are underutilized and vacant. The notable exception to industrial land use is commercial development characteristic of the Central Business District (CBD) which borders the tunnel segment following the Chicago River from Lake Michigan to Wolf Point. There are no residential land uses bordering the tunnel route. Rock taken from the tunnel will probably will be disposed of at McCook, Stearns, and Thornton quarries. Sludge will be disposed of at a number of sites or by a number of programs, including: the Fulton County landfill, NuEarch, broker sales, Landale Lagoons, and other landfills.

The land areas bordering the proposed tunnel route are expected to change to park, cultural, and recreational uses in the CBD-related sections but remain generally the same along other segments. Implementation of the Chicago 21 Plan would realize the Riveredge Plan, affecting redevelopment bordering the Main Branch of the Chicago River from Lake Michigan to Wolf Point. Substantial new recreational park development along the riveredges are envisioned.

Plans also call for the strengthening of the North Branch Industrial Area. Industrial uses along the Sanitary and Ship Canal are likely to continue because of the need for low-cost water transport. Improved water quality in the river and the canal plus storm water management would enhance the proposed Riveredge Plan and would help strengthen the industrial areas.

2.2.3 Sensitive Areas

There are no known archeological or historically significant sites bordering the tunnel route. MSD is presently investigating areas adjacent to planned tunnel routes. There are selected sites of historic and architectural interest within the vicinity of the tunnel route, but none within the immediate 500-foot impact area of the tunnel. These sites are listed on pages III-16 and III-17 of the EIS.

2.2.4 Financial Resources

Financial resources are currently available to fund the Mainstream Tunnel system. TARP's Phase 1 tunnel system cost breakdown is approximately $1.03 billion[1] for water pollution elements and $8.1 billion for flood control measures. Operation and maintenance of TARP has been estimated at $1.0 million annually. The estimated cost of the Mainstream system alone is $508.2 million, with an annual maintenance cost of of $472,000.

Analysis of the funding resources required to finance the Mainstream Tunnel system reveals that sufficient funds are currently available from the Federal Government, the State, and the MSDGC. (See Section 3.3.1 of the EIS). Additionaly Federal Water Pollution Control funds of approximately $221.0 million and MSDGC funds of about $73.5 million will be required to meet the implementation plan for the other conveyance tunnel systems. In view of the sound fiscal posture of the MSDGC, the high funding priority assigned TARP by the State, and the very conservative estimates of future Federal appropriations, it can be reasonably assumed that future financing requirements can be satisfied.

Maintenance costs can either be covered through an *ad valorem* property tax, or through a user charge system based on water consumption. EPA favors the latter approach and has awarded the MSDGC two grants to develop such a user charge system.

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1 Cost estimates based on values presented in MSDGC's "Facilities Planning Study—MSDGC Overview Report," January 1975.

2.2.5 Labor Resources

Labor resources are considered adequate to meet construction and implementation needs of TARP and other projects. The diversified labor force in the Chicago metropolitan area is vulnerable to economic recession because of the emphasis upon manufacturing and nonservice employment. Thus, while national unemployment was about 8.4 percent in the third quarter of 1975, Cook County had a 9.6 percent rate, and the city of Chicago sustained a 11.2 percent rate of unemployment. Increasing productivity rates and an expanding labor force should contribute to keeping Chicago unemployment levels higher than the national rate for the next few years. Therefore, new employment opportunities presented by TARP and other projects should not experience a shortage of labor resources.

The labor force is predominantly male, with white collar workers comprising 53 percent of the labor force in the SMSA.

2.2.6 Transportation

Implementation of the Mainstream Tunnel system will involve use of roadways and waterways. Trucks carrying rock and spoil material from construction sites will utilize several surface streets and expressways in reaching the quarry sites. The roadways range from two-lane streets to six-lane divided highways. The Mainstream Tunnel route also is proximate to major Chicago waterways; the North and South Branches of the Chicago River and the Sanitary and Ship Canal. Other portions of TARP will be near the Calumet and Little Calumet Rivers, and the Calumet-Sag Channel. Waterborne commerce is important to the Chicago economy; of the 46.2 million tons of waterborne freight traffic handled by the Port of Chicago, 37 percent of 17.3 million tons are moved over the inland waterways.

2.2.7 Major Projects and Programs

Major projects and programs proposed over the next ten years in the vicinity of the Mainstream Tunnel route consist mainly of transportation system improvements. Major transportation-related improvements which are proposed include:

- Monroe Street Subway Line
- Franklin Street Subway Line
- Crosstown Expressway
- Columbus Avenue - Monroe to Wacker, and northside of the Main Branch to Ontario Street
- Lake Shore Drive - relocation and construction from Monroe to Wacker
- Ashland Avenue - improvements from 83rd Street to Addison Street
- Rail and truck terminal improvements.

Other public projects include the proposed acquisition of rights-of-way along the north side of the Sanitary and Ship Canal. These rights-of-way are privately owned, and used by Commonwealth Edison and Natural Gas Pipeline Company of America for energy transmission. The intent of the public acquisition would be to establish a permanent utility corridor to more efficiently service growing energy demands.

An addition to Lane Technical High School is proposed, which is near drop shaft number 85, and two construction shafts just south of Addison Street on the east side of the North Branch. No other expansion plans are proposed in the vicinity of the tunnel project.

- Prevent all backflows to Lake Michigan to protect water supply resources
- Reduce pollutant discharges caused by combined-sewer overflows
- Reduce flooding in the combined-sewer and downstream areas.

In the initial screening, 6 plans were eliminated and the remaining 17 were modified to meet the objectives more fully as well as to provide a more quantitative basis for comparison. The modifications were referred to as MODs, and consisted basically of a combination of different storage capacities and waterway improvement actions. The resulting MODs yielded 51 alternative subsystem plans, or subplans, to be evaluated by the FCCC. In the next screening phase, the FCCC defined eight principal parameters, including capital costs (1972 dollars), estimated annual operating and maintenance costs (1972), project benefits, land acquisition acreage, underground easement requirements, resident and business relocations, construction impacts, and operation impacts. A technical advisory committee was organized by the FCCC to evaluate the modified alternatives in detail using the eight parameters. The advisory committee's interim report, "Evaluation Report of Alternative Systems," recommended a 50,000 acre-feet (ac-ft) storage level, which was part of the modified alternative designated as MOD 3. After reviewing the report, the members of the FCCC unanimously concluded that the flood and pollution control plan should be in the form of one of the four Chicago Underflow plans developed (four of the seventeen plans) or a combination of these plans, along with the recommended storage level. The FCCC stated that, "These alternatives are less costly and more environmentally acceptable to the community than any of the other plans presented. Detail studies along the lines of these alternatives should proceed to develop the final plan layout."

3.2 PLAN SELECTION

In August 1972, the FCCC members presented their final recommendations in a report with seven technical appendices. The report recommended consolidating the favorable features of the four Underflow plans into the Tunnel and Reservoir Plan (TARP). TARP was developed further and refined, then

III. THE PROPOSED ACTION

Identifying and defining a plan and its systems and subsystems establishes the proposed action for which the environmental setting is described and the environmental impacts are assessed. The proposed action identified and defined for this EIS is the Phase I conveyance tunnel systems and their associated subsystems only. The planned storage reservoirs, waste treatment plant upgrading and expansion, on-line reservoirs, and instream aeration facilities were not included.

The information presented in Chapter IV and V of the EIS is summarized in this chapter and divided into seven parts:

- Alternative Plans
- Plan Selector
- TARP Tunnel Systems
- TARP Subsystems
- 59th-to-Addison Tunnel Segment
- Cost of Tunnel System and Subsystems
- TARP Financing.

3.1 ALTERNATIVE PLANS

Many plans to resolve the Chicago area's flooding and water pollution problems were developed during the past two decades by concerned government agencies, local organizations, and individuals. At first, the plans focused primarily on the flood control problem, however, as water quality conditions in the area worsened, more emphasis was placed on controlling the water pollution. A total of 23 plans were formulated, and many were evaluated in detail by a Flood Control Coordinating Committee (FCCC), consisting of representatives from the State of Illinois, Cook County, the MSDGC, and the city of Chicago.

In screening the alternative plans, the FCCC established overall flood and pollution control objectives which provided a basis for evaluating alternative plans. A plan was automatically rejected if it did not:

evaluated in detail with four selected alternatives and the "no-action" alternative. In this evaluation, 15 significant environmental impact parameters were identified as the basis for evaluation. The FCCC concluded that very few negative impacts are expected for any of the alternatives incorporating conveyance tunnels, and that adverse impacts will occur if the "no-action" alternative is chosen. The FCCC also concluded that the construction impacts of all plans on the environment will most likely be relatively short-term and localized. Finally, the beneficial impacts of the plans will far exceed the adverse impacts. Within the scope of the FCCC analysis, TARP had the highest ranking and was selected as the most suitable plan to solve the flood and pollution problems of the Chicago metropolitan area.

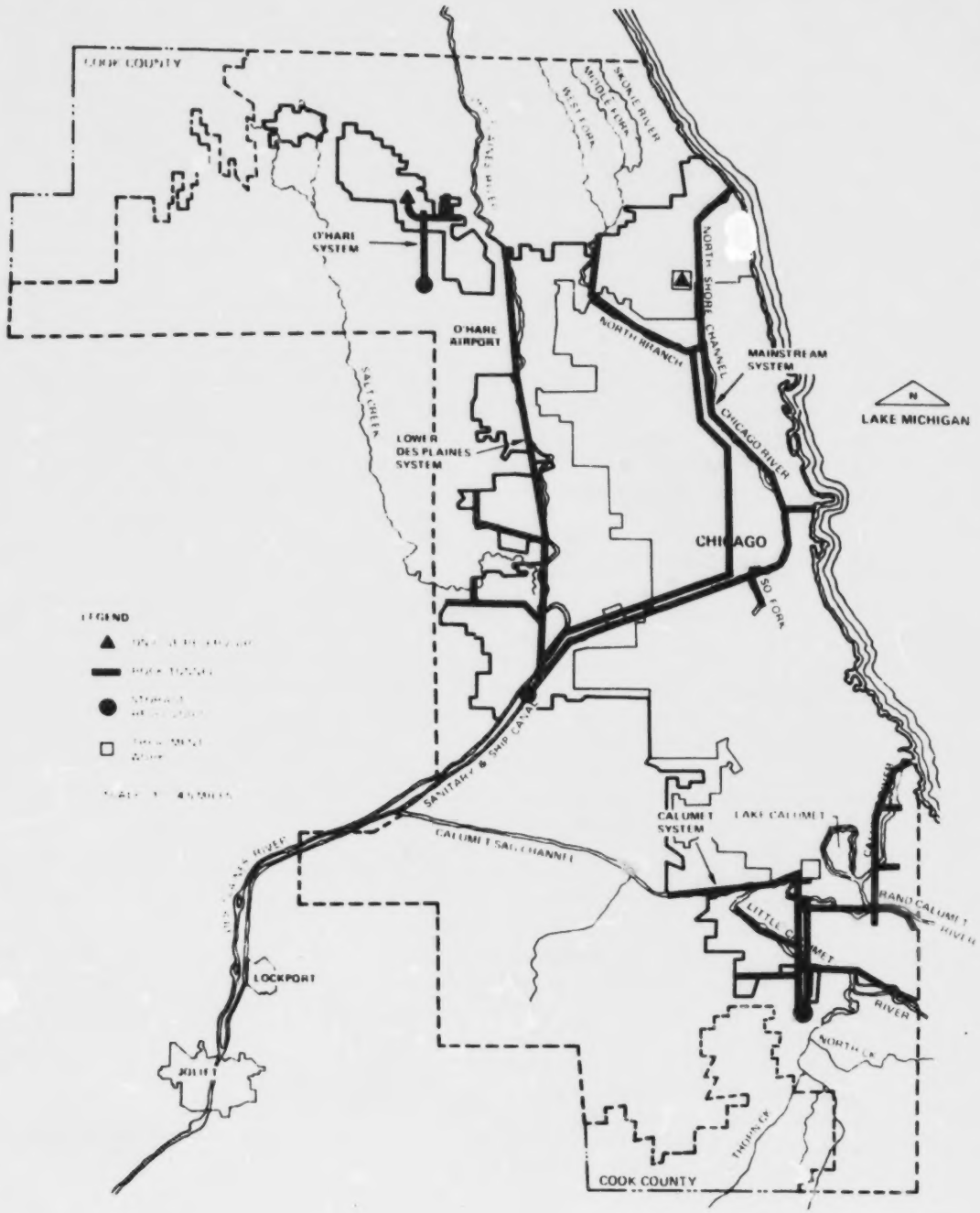
TARP would provide the most benefits for the lowest cost and the least adverse environmental impacts. Field studies and subsurface exploration programs further refined the plan; however, they did not change the original TARP concept. They were conducted only to optimize overall system effectiveness. Presently, TARP will enable collection of runoff water resulting from all but three of the severest rainfall storms recorded during the past 21 years.

3.3 TARP TUNNEL SYSTEMS

The four tunnel systems that are a part of the Tunnel and Reservoir Plan are the Mainstream, Calumet, Lower Des Plaines, and O'Hare systems. Each system is a completely independent operating unit with collection, storage, conveyance, and treatment capabilities. Figure III-1 shows the present routes and layout of these systems relative to the MSDGC combined-sewer service area, the MSDGC overall service area, and Cook County. Each of the TARP systems shown in the figure consists of three component systems: reservoirs, conveyance tunnels, and sewage treatment plants. A total of three reservoirs, 120 miles of conveyance tunnels, and four sewage treatment plants are included in the plan.

The TARP systems have two basic features which play a major role in solving the flood and pollution problems. First, the combined storage capacity of the plan is almost 115,000 ac-ft of which 105,800 ac-ft of the total is reservoir capacity and 9,200 ac-ft is tunnel capacity. The planned treatment capacity of TARP will be approximately 2,400 MGD. Second, over 640 existing overflow points will be eliminated within the MSDGC combined-sewer service area by the TARP systems.

FIGURE III-1
Tunnel and Reservoir Plan
System Layout and Routes



The proposed locations for the three reservoirs are: McCook quarry, Thornton quarry, and an area northwest of O'Hare International Airport. The conveyance tunnels, located 150 to 290 feet below ground level, will be constructed under existing waterways and public rights-of-way. Of the sewage treatment plants, three of the four plants are currently activated sludge plants with a combined planned capacity of approximately 2,150 MGD. The remaining plant is the proposed O'Hare-Des Plaines plant which will have a treatment capacity of over 70 MGD. A water reclamation plant, the John F. Egan plant, is presently under construction and the capacity will be 30 MGD.

3.4 TARP SUBSYSTEMS

The subsystems common to all TARP tunnel systems include drop shafts, collecting structures, and pumping stations. The drop shafts range from 4 to 17 feet in diameter and have two basic designs. One design features a slotted inner wall to assist in aerating the incoming water. The wall separates the air shaft from the water shaft and allows air either to enter or to escape while water is flowing in or being pumped out. The other design features a separate air shaft, to be installed in areas where high overflow rates prevail. The inside diameter of this drop shaft design ranges from 10 to 17 feet.

Approximately 640 collecting structures will be constructed to collect the overflows at established locations. The collecting structure basically consists of a diversion unit at the overflow point and a connecting pipe to the drop shaft entrance chamber. Most of the new structures will be constructed near curbs or in low points adjacent to major public thoroughfares.

Pumping stations will be constructed underground at the end of all conveyance tunnel routes and adjacent to all storage reservoirs. These stations permit a rate of dewatering of the tunnels and reservoirs which will allow a full tunnel or reservoir to be emptied within two to three days. The stations will also be used to transport bottom sludge dredged from reservoirs to treatment facilities.

3.5 59TH-TO-ADDISON TUNNEL SEGMENT

The Mainstream system of TARP consists of: two waste treatment plants with a total capacity of approximately 1,800 MGD; over 57 miles of conveyance tunnel with a storage volume of 3,180 ac-ft; and one main storage reservoir with a maximum capacity of 64,000 ac-ft. The component subsystems associated with the Mainstream system include 134 drop shafts; over 220 collecting structures; and two pumping stations, with one station located at the main storage reservoir. The system and its component subsystems will be constructed in two phases. In Phase I, approximately 40 miles of tunnel will be constructed, and in Phase II, the remaining 17 miles will be constructed. The Phase II tunnel route is almost parallel to the 59th-to-Addison segment of the Phase I tunnel, as shown in Figure III-1, and it will be used as a relief tunnel.

Phase I construction has already commenced on the North Shore Channel segment and on the North Branch-Chicago River segment. These segments, therefore, are not addressed in the Mainstream EIS. This EIS addresses the Phase I, 59th Street to Addison Street segment of the Mainstream system and focuses only on the conveyance tunnel system. The overall length of this tunnel segment is approximately 21 miles. The subsystems associated with it include 82 drop shafts, 5 construction shafts, 2 access shafts, 170 collecting structures, and 1 main pumping station.

3.6 COST OF TUNNEL SYSTEM AND SUBSYSTEMS

The MSDGC estimated cost[1] of a 10-foot diameter tunnel in rock with nominal aquifer protection is $200[2] per lineal foot. In rock with high quality aquifer protection, the cost is $230. Tunnel cost for soft ground construction is $350. Similarly, for a 35-foot diameter tunnel, the estimated costs are $1,030, $1,090, and $1,680 per lineal foot, respectively.

Large rectangular tunnels will be excavated by the drill and blast method and the estimated cost with nominal aquifer protection is $2,090 per lineal foot for a 40-foot diameter

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1 MSDGC, January 1975.

2 All cost figures presented in this section are based on 1972 values.

tunnel, and $2,580 for a 49-foot diameter tunnel. The same type and size of tunnels with high quality aquifer protection would cost an estimated $2,170 and $2,770 per lineal foot, respectively.

The tunnel costs estimated above include the following base figures:

- Cost of muck disposal, estimated to be $4.00 per solid cubic yard
- Nominal grouting[1] for control of infiltration during construction, estimated to be $0.30 per square foot of tunnel wall
- Access and ventilation shaft construction
- Ventilation and hoist equipment
- Grout and grout inspection equipment
- Average aquifer protection costs.

Additional grouting for aquifer protection in unlined tunnel segments in the upper aquifers is estimated to cost $1.50 per square foot of tunnel wall. This grouting would be provided to a depth of about one tunnel diameter beyond the excavated tunnel limit.

The total construction cost for all the TARP tunnel systems is approximately $567 million. The estimated total costs for the subsystems are: $93 million for collecting/connecting structures, and $38 million for pumping stations. These subsystem costs are based on the following:

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1 Grouting is a procedure whereby a mixture of cement and water is injected under pressure into a drilled hole that intersects a source of seepage such as an open joint, fault, or bedding plane.

- Collecting Structures and Connecting Lines. The cost of the near-surface collection structures leading to the drop shafts includes the gravity interceptor sewers and the necessary connecting structures. Table III-1 lists the costs for these subsystems with respect to the TARP tunnel systems.

Table III-1
Estimated Costs For
Collecting Structures and Connecting Lines

Tunnel System	Estimated Cost ($ Million)		
	Intercepting Structures	Collection System	Total
Mainstream	8.701	3.648	12.349
Calumet	1.084	1.088	2.172
Lower and Upper Des Plaines	1.043	3.489	4.532
TOTALS	10.828	8.225	19.053

- Drop Shafts. The estimated cost of drop shafts includes all drop shaft components. The costs are related to the shaft diameter and to the depth of penetration into the rock formations. The cost of 250-foot deep drop shafts varies from $80,000 for a shaft two feet in diameter to $1,400,000 for a 20-foot diameter shaft. Continued development of the "raise-bore" machines could reduce the cost of shafts in rock by reducing excavation costs and by eliminating concrete linings.

- Pumping Stations. The estimated construction cost of pumping facilities includes the structure, pumping equipment, power generation for the operation of larger units, and discharge piping to the appropriate treatment plant. The estimates have been based on use of variable-speed, motor-driven units. Total capital costs for pumping vary as follows:

Lift Height	Estimated Cost ($ Million) Pumping Capacity 1000 cfs	100,000 cfs
300 feet	5.6	200
525 feet	5.7	300

3.7 TARP FINANCING

Financing of the entire $3.54 billion MSDGC Flood and Pollution Control Plan over the next 11 years is doubtful. As illustrated in Table III-2, however, the financing requirements for all conveyance tunnels could be met by a modest increase in Federal and MSDGC funding over a period of 11 years, from 1976-1986. An additional $220.0 million appropriation of Federal funds and an additional $73.5 million of MSDGC funds are estimated to be required to finance the three (Mainstream, Calumet, and Lower Des Plaines) TARP tunnel systems. The additional Federal funds represent a modest portion (28.3 percent) of the conservatively estimated $780 million of new PL 92-500 money which is expected to be forthcoming to MSDGC over the next six fiscal years. Congress, however, has not yet approved any additional appropriation beyond the initial $18 billion which was authorized under PL 92-500 and totally allocated over the FY 1972-1976 period. The $73.5 million of MSDGC funds represents an increase of about 19 percent over the current MSDGC bonding authorization. This amount, however, represents a very modest proportion of the additional $200-400 million bonding authorization for which MSDGC is currently formulating plans to ask the State of Illinois.

If the tunnel phase of TARP is not implemented, there is a very high probability that approximately 90 percent of the currently available Federal funds assigned to the MSDGC will be lost by both the State of Illinois and the MSDGC. This potential loss to the MSDGC and state stems from the fact that the Calumet and North-Side treatment facilities expansion project, (which represent the next major projects in terms of priority for Federal funds) will not meet the September 30, 1977 deadline for Step 3 funding eligibility. Assuming these two projects did not qualify in time for existing Federal funds, it is estimated that only approximately 10 percent of the $323.6 million could alternatively be allocated to other MSDGC or statewide prioritized pollution control projects.

The financing feasibility of other key elements (non-TARP) of the MSDGC's Flood and Pollution Control Plan (see Table III-2), which are closely related to the overall goal of meeting the 1983 water quality standards, ranges from almost certainty to near zero. Addressing these elements in the order of priority specified in the MSDGC's 1975 Facilities Plan, instream aeration stands next in line behind the conveyance tunnels. The approximately $16.7 million required for instream aeration can easily be met from

TABLE III-2
Financing Schedule - Tunnel Plan and Other Major Elements of MSDGC and Pollution Control Plan

Priority List of Projects	Estimated Costs[1]	EPA			STATE OF ILLINOIS								
		Currently Available[2]	Currently Projected[3]	Additionally Required[4]	Currently Available	Currently Projected	Additionally Required	Currently Available[5]	Currently Projected[7]	Additionally Required	Currently Available[8]	Currently Projected[9]	Additionally Required
1. Conveyance Tunnels	1,012.4	172.4[10]	220.0	0.0	100.0	0.0	0.0	66.3	73.5	0.0	0.0	0.0	0.0
2. Instream Aeration	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.0	0.0	0.0	0.0
3. Treatment Plant Upgrading[11]	1,171.4	0.0	540.0	0.0	0.0	0.0	0.0	0.0	200.0-202.6	0.0-183.1	0.0	0.0	0.0
a) North-	152.3	0.0	114.2	0.0	0.0	0.0	0.0	0.0	18.1	0.0	0.0	0.0	0.0
b) Cal.-Sag	332.6	0.0	264.6	0.0	0.0	0.0	0.0	0.0	71.7-88.2	0.0-16.5	0.0	0.0	0.0
c) West-South-west	686.5	0.0	161.2	0.0	0.0	0.0	0.0	0.0	0.0-166.6	0.0-166.6	0.0	0.0	0.0
4. Reservoirs and Flood Control	610.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	610.1
Total[12]	3810.6	172.4	760.0	317.5	100.0	0.0	0.0	66.3	200.0-183.1	0.0-183.1	0.0	0.0	610.1

FOOTNOTES

1 All cost estimates are based on those presented in the MSDGC's Facilities Planning Study (January 1975) and are escalated 6 percent annually for inflation.

2 These funds represent the remainder of the FY 1975 and FY 1976 PL 92-500 appropriation which are expected to be allocated to MSDGC by the State.

3 These are Federal funds, above and beyond the existing PL 92-500 appropriation, which are expected (in the form of a new appropriation) over the period FY 1977-1982.

4 These are Federal funds above and beyond the additional $780 million expected over the FY 1977-1982 period.

5 These are funds, under the State's current $750 million bonding authorization, which are expected to be available to MSDGC to finance the Tunnel Plan.

6 The funds in this category represented those available by virtue of the unused bonding authority of the MSDGC under the current $380 authorization.

7 This category represents funds expected to be available under an additional $200 to $400 million bonding authority for which the MSDGC is currently formulating plans to ask the State of Illinois.

8 There is no current COE appropriation for any MSDGC Flood and Pollution Control Plan elements.

9 There is no near future COE appropriation expected for any MSDGC Flood and Pollution Control Plan elements.

10 Includes approximately $49.6 million already obligated to the North Shore section of the Mainstream Tunnel Plan (Addison-Wilmette segment).

11 Figure doesn't include the estimated $124 million already obligated for the O'hare treatment plant project.

12 The total estimated cost $3030.6 million differs from the $3536.5 million (Table III-10 of the main body of the EIS) because of the exclusion of the following projects: sewers, solids disposal, O'hare Treatment plant, and food control(non-TARP).

existing state and MSDGC funding sources. It is very unlikely, however, that the financing will be available to increase the treatment levels, efficiencies, and capacities at all the treatment plants (Northside, Calumet, and West-Southwest). The total required financing ($1.17 billion) would necessitate a significant increase above the additional levels of Federal ($780 million) and MSDGC ($200-400 million) funds expected to be available over the FY 1977-1986 timeframe. The financing feasibility of the Northside and Calumet treatment plant expansions, however, is reasonable in view of their combined total estimated costs of $505.1 million. The Federal funding portion ($378.8 million) could be provided from the additional $780 million PL 92-500 appropriation expected over the next six years. The MSDGC portion ($126.3 million) could be provided from the anticipated $200-400 million additional bonding authorization.[1] In terms of the West-Southwest treatment plant expansion project (estimated cost of $666.3 million), the financing feasibility is very questionable in view of the requirement for additional funds beyond the levels (Federal and MSDGC) expected to be available over the period FY 1977 to 1986.

Funding for the reservoir and flood control tunnels is currently nonexistent; in addition, there is no reasonable expectation that any significant financing will be forthcoming in the near future. A determination at the Washington level concerning the role of the Corps of Engineers in urban drainage improvement has not been made. In view of the complexity of this issue, it is very unlikely that Federal funds for the reservoirs and flood control tunnels will be available in the near future.

The operation and maintenance costs of the TARP tunnel systems will be financed by a user charge system rather than the current ad valorem tax system. PL 92-500 requires the development of a user charge system and the State of Illinois presently has the authority to impose a user charge. This system of financing the annual operations and maintenance costs of the tunnel systems is not expected to have a significant economic impact in the commercial, industrial, and household sectors. The incremental charge in the MSDGC tax rate per $100 of assessed valuation (1975 rate was $.4005) is estimated to be $.0541 (for operations and maintenance) and $.0532 (for tunnel construction) by the year 1986. The

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1 However, to provide the $126.3 million, the MSDGC's additional bonding authorization must be at least $216.5 million.

tunnel construction impact will continually decline after 1986 with the continuing growth of the tax base. Details of this financial system are provided in the EIS in Sections 3.3.1 and 9.3.

IV. PRINCIPAL FINDINGS CONCERNING THE EFFECTS OF THE PROPOSED ACTION

Chapters VI through IX of the EIS assess the beneficial and adverse effects of the construction and operation of the conveyance tunnel systems on greater Chicago's natural and man-made environments. This chapter presents the principal findings of that analysis only for those effects expected to be relatively significant.

The most significant finding relates to the expected improvement in water quality resulting from the operation of the three tunnel systems. To assess the significance of this improvement the EIS considers the possible and likely cumulative effects of other components of TARP which are not directly the subject of this EIS. These other components are the reservoirs, treatment plant improvements, and instream aeration. The environmental effects associated with these components were not otherwise assessed in this EIS.

The principal findings of the EIS are presented under the following subsections:

(1) Effects of Operation on Water Quality

(2) Effects of a Significant Earthquake on Tunnel System

(3) Effects of Shale Deterioration on Tunnel Stability

(4) Effects of Rock Spoil Generated During Construction

(5) General Effects of Construction

(6) Effects of Infiltration and Exfiltration

(7) Worker Safety During Construction

(8) Effects of Operation on Land Use

(9) Effects of Construction on Employment.

(1) Effects of Operation on Water Quality

THE TUNNEL WILL SIGNIFICANTLY REDUCE THE POLLUTANT LOAD CURRENTLY DISCHARGED TO CHICAGO'S WATERWAYS, HOWEVER, THE TUNNELS ALONE WILL NOT RESULT IN ATTAINING APPLICABLE ILLINOIS WATER QUALITY STANDARDS, AND, THEREFORE, WILL NOT ENABLE ADDITIONAL USES OF THE AFFECTED WATERWAYS. ALTHOUGH THE TUNNELS ALONE WILL NOT RESULT IN ATTAINING THESE STANDARDS, OPERATION OF THE TUNNELS WITHOUT OTHER POLLUTION CONTROL MEASURES FOR WHICH FUNDING IS UNCERTAIN WILL ENABLE POLLUTION CONTROL GOALS TO BE AT LEAST PARTIALLY ACHIEVED.

This conclusion is based on the following findings:

- The tunnels will capture approximately 75 percent of the pollutant load now discharged during combined-sewer overflows and will reduce the frequency of overflows from 100 to 10 times per year. 1977 Illinois water quality standards will continue to be violated during overflow events because of uncontrolled injections of pollutants into the waterways.

- The tunnels may not result in the attainment of 1977 Illinois standards for ammonia and possibly for phosphorus (effluent standards) over lengthy reaches of waterway, because high concentrations of these two pollutants are discharged from local wastewater treatment plants. Although data is not presently available to allow a more definitive determination of effects on this point, the attainment of water quality standards in the area's major river systems is clearly and intimately tied to the upgrading and expansion of MSDGC treatment plants.

- With the tunnels on line, 1977 Illinois standards of 4 mg/l for dissolved oxygen (DO) will still be violated along approximately 50 of the 80 miles of the Main Channel and of the Calumet River systems during the critical late summer months. Conditions along the Des Plaines River system have not yet been modeled by the MSDGC, but will be completed under the Section 208 planning program.

- Implementation of the reservoirs in addition to the TARP tunnel systems will effectively eliminate combined-sewer overflows to surface waterways, thus averting violations of water quality standards due to wet weather conditions. However, the combination of tunnels and reservoirs will still not enable attainment of the 1977 DO standard over roughly 40 of the 80 miles of waterways during the late summer months.

- Implementation of the tunnels and reservoirs in conjunction with upgrading of treatment plants is projected to have a beneficial effect on DO concentrations, but the combination will still fail to meet 1977 Illinois standards along approximately 24 of the 80 miles of waterways modeled. The time period will be the same as previously stated.

- 1977 Illinois standards for DO are likely to be met over the entire 80-mile length of the modeled waterways during critical summer dry flow conditions, assuming implementation of the following pollution control components:

  - Tunnels
  - Reservoirs
  - Treatment plant improvements
  - Instream aeration.

- The water quality impact of these various pollution control options is summarized in Table IV-1.

- Given current projections of Federal, State, and MSDGC financing capabilities and policies, the financing of the tunnels and instream aeration appears secure. The financing of the Calumet and North-Side treatment plant expansions is probable; but financing the costly West-Southwest treatment plant is very doubtful. The financing of the reservoirs in the near future is very unlikely given the absence of any Federal commitment to provide assistance.

Additional details on water quality are provided in Sections 2.1 and 8.1 of the EIS text and details on financing in Section 3.3.1.

Table IV-1
Impact of Potential Pollution Control Options on Water Quality Along Main Channel and Calumet River Systems[1]

Notes (a) Tunnels plus instream aeration effects addressed in Section 8.1.1 of EIS.
(b) Phasing of options shown in order adopted by MSDGC in modeling studies.

Water Quality Component \ Pollution Control Option	No Action	Phase I Tunnels	Tunnels Plus Reservoirs	Tunnels Plus Reservoirs Plus Treatment Plant Upgrading[2]	Tunnels Plus Reservoirs Plus Treatment Plant Upgrading Plus Instream Aeration
Combined-Sewer Overflows	Overflow to waterways 100 times per year. Illinois standards violated most of the time.	Overflows reduced from 100 to 10 per year. 75 percent of pollutant load captured and treated.	Overflow effectively eliminated. Wet weather flows cease to affect water quality.	No significant change	No significant change
Ammonia and Phosphorus Levels[3]	Ammonia standard violated by treatment plant discharges; phosphorus standard violated during overflow.	Ammonia and (possibly) phosphorus standards violated due to treatment plant discharges.	No significant change	Ammonia and phosphorus standards met.	Ammonia levels in waterways improved beyond standard, phosphorus standard met.
Dissolved Oxygen (DO) Concentrations[4]	DO levels below Illinois standards along 80 percent of waterways. Anaerobic conditions exist over large stretches.	DO levels below Illinois standards along 70 percent of waterway. Anaerobic conditions greatly relieved.	DO levels below Illinois standards along 50 percent of waterway. Anaerobic conditions rare.	DO levels below Illinois standards along 35 percent of waterway. Anerobic conditions eliminated.	Illinois standard met over entire 80-mile length of waterway. Anerobic conditions completely eliminated.
Allowable Water Uses	Illinois water use standards not met along area waterways.	No significant change	No significant change	Illinois water use standards met along 65 percent of waterway.	Illinois water use standards met. Fishing, boating, and shoreline activities permitted.

1 Computer simulations of dissolved oxygen concentrations along the Des Plaines River not yet available.

2 Upgrading to tertiary level assumed with nitrogen and phosphorus removal.

3 Secondary Contact and Indigenous Aquatic Life Standards for ammonia and phosphorus identical to Effluent Standards.

4 Computer simulations of dry weather flow conditions.

(2) Effects of a Significant Earthquake on Tunnel System

IF A SIGNIFICANT EARTHQUAKE OCCURS IN THE CHICAGO AREA, THE EVENT MAY OFFSET TUNNEL ALIGNMENT AND CAUSE SIGNIFICANT DAMAGE TO PORTIONS OF THE TUNNEL SYSTEM.

This conclusion is based on the following findings:

- The 175-year historical earthquake records indicate that a seismic event with a Modified Mercalli Intensity (MMI) of VIII can recur in the Chicago area at a rate of about once per 100 years. Assuming the tunnel system is in operation for 100 years, the probability of this event occurring at some time during this period is 100 to 1 or 10,000 to 1 for any given year. If an MMI VIII event occurs, severe alterations to tunnel alignment or tunnel surface may result.

- The conveyance tunnels will pass through several active faults prevalent in the TARP project area and will be sensitive to earth movement at these locations. Information on the distribution and nature of the active faults is insufficient to assess accurately the extent of damage which could result from an MMI VIII earthquake.

Further information on this subject may be found in Sections 2.2.3, 2.2.4, and 8.2.2 of the EIS.

(3) Effects of Shale Deterioration on Tunnel Stability

FOR THOSE SEGMENTS OF THE TUNNEL SYSTEM WHICH ENTER SHALE FORMATIONS, TARP CONSTRUCTION AND OPERATION MAY BE AFFECTED BY SHALE DETERIORATION.

This conclusion is based on the following findings:

- Certain sections of the TARP tunnel systems will be aligned within Maquoketa shale. During excavation activities in this rock series, rockfalls and partings (loosened material) will occur and may

cause construction delays or safety problems. Delays can range from several weeks to several months and are costly in terms of labor, equipment, injuries, and lost time. The $30 million (1972 base) contingency fund established in the TARP budget is expected to be sufficient to cover the costs of delays.

- Concrete lining is expected to deter, but not fully to eliminate, shale deterioration. Most of the TARP tunnel systems will be concrete-lined and located in Silurian dolomite rock. Short lengths of conveyance tunnel, however, will be in shale formations, and deterioration (i.e., erosion) will occur over a long period of time as a result of water seepage or exfiltration. If deterioration becomes extensive, additional stress will be placed on the lining, and it may cause fracturing or cracking of the lining.

Sections 6.2.2, 8.2.2, and 10.1.2 (2) provides additional information on the subject matter of this finding.

(4) Effects of Rock Spoil Generated During Construction

THE ROCK SPOIL MATERIAL GENERATED DURING TUNNEL CONSTRUCTION IS NOT EXPECTED TO BE MARKETABLE. THEREFORE, ENVIRONMENTAL IMPACTS ASSOCIATED WITH DISPOSAL OF THE ROCK SPOIL WILL DEPEND LARGELY ON THE AVAILABILITY OF LANDFILL DISPOSAL SITES.

Approximately 4,540,000 cubic yards (bulk measure) of spoil will be removed from the Mainstream Tunnel in the 59th Street to Addison Street segment, which is approximately 53 percent of the total removed from the entire Mainstream Tunnel system. Although this amount can be adequately contained within the inactive Stearns quarry, the large quantities of spoil involved in reservoir excavation could complicate disposal plans for tunnel spoil. Disposal of rock spoil from the reservoirs was addressed briefly in Section 6.2.4 of the EIS. A significant portion of rock spoil generated by reservoir construction is likely to be marketable and to be stockpiled on the quarry site for eventual sale by the quarry owners.

Major findings supporting the above conclusions are:

- Shale and other constituents present in the rock excavated from the Phase I tunnels will limit the rock's suitability for low-grade commercial uses.

- Landfill disposal sites capable of accepting the entire volume of tunnel spoil to be generated during TARP Phase I have not yet been identified by the MSDGC.

- The inactive Stearns quarry has enough volume to accept the entire quantity of spoil to be excavated from the Mainstream Tunnel 59th Street to Addison Street segment (53 percent of total Mainstream Tunnel system).

- Since conventional methods will be used to excavate rock from the McCook and Thornton quarries for reservoir construction, it is likely that a significant portion of the spoil will be marketable. Present plans envision stockpiling the saleable portion on the quarry sites for eventual sale by the quarry owners. Various stockpile configurations are being considered. Nonsaleable spoil will be stockpiled either on-site, as is proposed for the McCook quarry site, or at an off-site location owned by the MSDGC, as is proposed for the Thornton quarry material.

A more detailed discussion is provided in Section 6.2.4 of the EIS.

(5) General Effects of Construction

CONSTRUCTION OF THE TARP TUNNEL SYSTEMS WILL RESULT IN TEMPORARY PUBLIC ANNOYANCE AND INCONVENIENCE FROM THE CUMULATIVE EFFECTS OF NOISE, HANDLING OF CONSTRUCTION DEBRIS, VIBRATION FROM BLASTING, DISRUPTION OF VEHICULAR AND PEDESTRIAN TRAFFIC, AND GLARE FROM THE ILLUMINATION OF CONSTRUCTION AREAS AT NIGHT. ALTHOUGH THE CUMULATIVE EFFECTS MAY BE NOTICEABLE, TAKEN SINGLY, EACH EFFECT IS MINOR.

This conclusion is supported by the following findings:

- Surface construction sites are located in areas which are generally either vacant or near low-utilized industrial land.

- Noise at each construction site should be within levels mandated by Chicago ordinances and, at each surface construction site, noise will only occur for periods of three to nine months.

- Because blasting will be used only to excavate shafts and not the tunnel, itself, blasts will be relatively infrequent and will continue at any one site for not more than 120 days.

Further information on this subject may be found in Sections 6.3.1, 6.3.2, 7.1.1, 7.2.1, 7.4, and 10.2.

(6) Effects of Infiltration and Exfiltration

IF THE GROUTING PROGRAM IS NOT EFFECTIVE,[1] GROUNDWATER INFILTRATION DURING CONSTRUCTION AND WASTEWATER EXFILTRATION DURING TUNNEL OPERATION CAN BE A SIGNIFICANT PROBLEM.

This conclusion is supported by the following findings:

- The inflow rate of groundwater for the TARP tunnel systems is estimated to be an average of approximately 0.5 MGD per mile of tunnel. In the absence of appropriate mitigative measures, this rate is sufficient to lower the piezometric or hydraulic pressure level of the upper aquifer. Tunnel grouting is the most effective method to reduce infiltration and a grouting program has been incorporated in TARP. Grouting integrity, however, must be maintained to keep inflows below the allowable limit of 500 gallons per day per inch of tunnel diameter per mile of tunnel. Observation wells will be required to monitor integrity throughout the operational phase of the tunnel.

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1 The objective of grouting is to achieve maximum penetration and a uniform grout spread. If grouting is ineffective, maximum infiltration/exfiltration flows will result.

- Exfiltration will most likely occur when tunnel pressures exceed inflow pressures during high storm runoff conditions. The TARP grouting program is expected to prevent extensive exfiltration of tunnel wastewaters into the upper aquifer. However, if grouting integrity is not maintained during tunnel operation, exfiltration will be at a high enough rate to degrade groundwater quality of the upper aquifer. Observation wells will be necessary to determine whether exfiltration is occurring along the tunnel routes.

EIS Sections 2.1.2, 6.1.2, and 8.1.2 provide more information on the subject of groundwater infiltration and wastewater exfiltration. Specifications for observation well spacing and for the monitoring program are also presented in these sections.

(7) Worker Safety During Construction

TUNNEL OR UNDERGROUND CONSTRUCTION WORKERS WILL BE MORE SUSCEPTIBLE TO INJURY, DISABILITY, AND FATALITY THAN SURFACE CONSTRUCTION WORKERS. THE INCIDENCE OF INJURIES AND FATALITIES, HOWEVER, IS NOT EXPECTED TO BE GREATER THAN NORMAL FOR THIS TYPE OF CONSTRUCTION WORK.

This conclusion is supported by the following findings:

- Based on recent national statistics for all types of construction activities, the Mainstream Tunnel system construction may result in 90 disabling injuries and in one permanent disability or fatality. For construction of the entire tunnel system, injuries and fatalities are expected to increase proportionately.

- Based on the safety statistics of the current construction of a rapid-transit system subway in Washington, D.C., construction of the entire TARP tunnel system could result in 1,829 injuries and in 11 fatalities.

- Analysis of the geologic and seismic characteristics of the project area indicates that most of the area is stable and suitable for the construction of underground tunnels. Precautionary measures will be required to protect workers in segments where rockfall and partings (loosened material) may occur frequently and shale deterioration conditions prevail.

Further information on this subject may be found in Sections 6.2.2 and 7.1.2.

(8) Effects of Operation on Land Use

THE QUALITY OF LAND IN CERTAIN RIVERBANK SECTIONS ALONG THE 59TH-TO-ADDISON MAINSTREAM TUNNEL ROUTE MAY BE ENHANCED BY REDUCED FLOODING CONDITIONS.

Vacant land exists between the North Branch-Chicago River and North Leavitt Street (bounded by West Oakdale Avenue on the north and North Hayne Avenue on the south) in a residential area. The reduction of flooding in this area will enable development of this under-utilized land into such uses as: parks, single and multifamily residences, apartments, and commercial establishments. If the land is developed into either multifamily residences, apartments, or commercial establishments, assessed valuation of land will increase and, thus, taxation increases.

(9) Effects of Construction on Employment

CONSTRUCTION OF THE MAINSTREAM TUNNEL WILL PROVIDE OVER $87 MILLION IN CONSTRUCTION INCOME OVER A SEVEN-YEAR PERIOD AND WILL CREATE A PEAK SUPPLY OF APPROXIMATELY 800 JOBS OVER A THREE-YEAR PERIOD.

Further information may be found in Section 7.1.3.

V. CONCLUSIONS AND RECOMMENDATIONS

The following is a summary of the principle conclusions of the Draft EIS, as well as recommended and suggested mitigative measures.

1. Implementation of the Mainstream Tunnel system will significantly reduce the pollutant load in the Chicago waterways. These loadings will be reduced further with the implementation of the Calumet and lower Des Plaines Tunnel systems. Water quality will be enhanced further with the upgrading of MSDGC's treatment facilities and the construction of the flood control aspects of the Tunnel and Reservoir Plan.

2. Significant earthquake events could adversely affect tunnel alignment and tunnel lining. Smaller earth movements could also affect the lining and grouting of the tunnels. It is, therefore, essential that MSDGC's inspection and maintenance program be extensive enough to insure efficient operation of the system.

3. Rock falls and partings may occur particularly in shale formations during construction. Stabilizing measures such as rock bolting are proposed to mitigate the short-term construction problems, while concrete lining will be utilized for the long term. Even with these measures, shale deterioration will continue and the inspection program should take these sensitive areas into account.

4. The rock spoil excavated from the Phase I tunnels is not expected to be marketable. Evaluation of various disposal alternatives leads to the conclusion that adequate environmentally acceptable landfill sites are available to handle the volume of rock which will be generated by the Phase I tunnels under consideration. We will rely on existing local, state, and Federal regulations to insure that disposal takes place in an acceptable manner.

5. Although an effective grouting program is proposed, it must be sufficiently flexible to respond to the actual conditions encountered during construction. Should the grouting not be sufficient, additional infiltration could adversely affect the hydraulic pressure of the upper aquifer.

Additionally, under surcharged conditions, exfiltration will occur, resulting in adverse impacts on the groundwater quality of the upper aquifer. Observation wells to monitor grouting integrity during operation are necessary along the entire tunnel alignment. An adequate number of wells are already in existence for the Mainstream Tunnel system. If pollutants are detected in the observation wells, additional mitigative measures must be implemented to protect the upper aquifer, including a groundwater recharge system. Chapter X discussed particular aspects of the monitoring program.

6. Since the majority of the construction shafts and drop shafts are in close proximity to area waterways, runoff from these sites could adversely affect water quality. Berms will be constructed around stockpiles of construction materials and spoil materials to preclude runoff into the waterways.

7. It is presently proposed that water pumped from the tunnels during construction be discharged directly to the waterways after a period of settling. Since the possibility of silt and other pollutants still exists after settling, it is recommended that these dewatering flows be discharged to MSDGC's intercepting system for treatment.

8. Although no known historic, architectural, or archaeological resources will be affected by the proposed project, the possibility of finding archaeological resources must be investigated by the MSDGC. This must be accomplished by contacting the State Historic Preservation Officer.

9. Conformance with applicable regulation of the Occupational Health and Safety Administration, U.S. Department of Labor, and the Bureau of Mines, U.S. Department of the Interior is essential for safety of construction workers.

10. A conflict exists between the location of several drop shafts and the plans for the Central Area Transit Project. The MSDGC must meet with the Chicago Urban Transportation District to resolve these conflicts.

11. There exists a wide range of potential adverse impacts which could develop during construction. This includes blasting, waste spillage, traffic congestion, light glare, and fugitive dust at construction and disposal sites. While these effects could be considered insignificant any measures taken to reduce their impact would aid in public acceptability of the project. These suggested mitigative measures are discussed in Chapter X.